WHAT IS CLAIMED IS:

1. A weighting coefficient determining method in a subtractive interference canceller for digital radio communications wherein the communication channel is composed of pilot bits, other control bits and data bits;

the weighting coefficient determining method being characterized in that the weighting coefficient λ_A^Q of the pilots bits, the weighting coefficient λ_B^Q of the other control bits and the weighting coefficient λ^I of the data bits are mutually independent values.

2. A weighting coefficient determining method according to claim 1, wherein said weighting coefficients λ_A^Q, λ_B^Q and λ^I are determined for each user and stage based on a tentative decision symbol and an average or instantaneous signal-to-interference ratio SIR.

3. A weighting coefficient determining method according to claim 2, wherein signal-to-interference ratios SIR_I and SIR_Q respectively of an I branch and a Q branch are used as the signal-to-interference ratio SIR, and the weighting coefficients λ^I and λ^Q of the I branch and Q branch are derived from tentative decision symbol and a tentative decision error probability density function derived from the signal-to-interference ratios SIR_I and SIR_Q.

4. A weighting coefficient determining method in a subtractive interference canceller adapted for digital radio communications, wherein the weighting coefficients are set so as to minimize the power of the interference cancellation residual signal for each channel in each stage.

5. A weighting coefficient determining method according to claim 4, wherein said weighting coefficients are derived based on the relationship expressed by the following equation:

[Eq. 46]

$$\lambda_{k,l}^{s}(H_{k,l}^{s}, B_{k}^{s}) = \frac{\int dh_{k,l} \int db_k h_{k,l} b_k f(h_{k,l}, H_{k,l}^{s}, b_k, B_{k}^{s})}{H_{k,l}^{s} B_{k}^{s}}$$

wherein $\lambda_{k,l}^{s}$ denotes the weighting coefficient of the l-th path for the k-th user in the s-th stage;

$H_{k,l}^{s}$ denotes the estimated channel of the l-th path for the k-th user in the s-th stage;

B_k^{s} denotes the tentative decision symbol of the k-th user in the s-th stage;

$h_{k,l}(t)$ denotes the channel coefficient of the l-th path for the k-th user;

b_k denotes the signal received by the k-th user; and

$f(h_{k,l}, H_{k,l}^{s}, b_k, B_k^{s})$ is a combined tentative decision error probability density function relating to the channel coefficient $h_{k,l}$, the estimated channel $H_{k,l}$, the received signal b_k and the tentative decision symbol B_k^{s}.

6. A weighting coefficient determining method according to claim 5, wherein said weighting coefficients are approximated as follows:

[Eq. 47]

$$\lambda_{k,l}^{s}(H_{k,l}^{s}, B_k^{s}) \cong \frac{\int db_k b_k f(h_{k,l}, H_{k,l}^{s}, b_k, B_k^{s})}{B_k^{s}}$$

7. A weighting coefficient determining method according to claim 6, wherein said weighting coefficients are further determined by taking the received signal b_k as follows:

[Eq. 48]

$$b_k = A_k^{s} e^{i\varphi_k^{s}}$$

and using the following relationship:

[Eq. 49]

$$\frac{\int db_k b_k f(h_{k,l}, H_{k,l}^{s}, b_k, B_k^{s})}{B_k^{s}} = \int db_k A_k^{s} e^{i\phi_k} f(h_{k,l}, H_{k,l}^{s}, b_k, B_k^{s})$$
$$= f(h_{k,l}, H_{k,l}^{s}, B_k^{s}, B_k^{s}) + f(h_{k,l}, H_{k,l}^{s}, e^{i\varphi_I} B_k^{s}, B_k^{s}) e^{i\varphi_I}$$
$$+ f(h_{k,l}, H_{k,l}^{s}, e^{i\varphi_Q} B_k^{s}, B_k^{s}) e^{i\varphi_Q} - f(h_{k,l}, H_{k,l}^{s}, e^{i\pi} B_k^{s}, B_k^{s})$$

wherein φ_I and φ_Q are phase errors when only the I or Q phase contains measurement errors, and are expressed as follows:

[Eq. 50]

$$\varphi_I = \operatorname{sgn}(\operatorname{real}(B_k^s))\operatorname{sgn}(\operatorname{imag}(B_k^s))2\left(\frac{\pi}{2} - \operatorname{atan}\left|\frac{\operatorname{imag}(B_k^s)}{\operatorname{real}(B_k^s)}\right|\right)$$

$$\varphi_Q = -\operatorname{sgn}(\operatorname{real}(B_k^s))\operatorname{sgn}(\operatorname{imag}(B_k^s))2\operatorname{atan}\left|\frac{\operatorname{imag}(B_k^s)}{\operatorname{real}(B_k^s)}\right|$$

and the terms on the righthand side of Equation 49, using the signal-to-interference ratio $SIR_{I(Q)}$ of the I(Q) branch and the tentative decision error probability of the I(Q) branch:

[Eq. 51]

$$g(SIR_{I(Q)} \mid h_{k,l}, H_{k,l}^s, b_k, B_k^s) = \frac{1}{\sqrt{2\pi}} \int_{\sqrt{SIR_{I(Q)}}}^{\infty} e^{-\frac{x^2}{2}} dx$$

are expressed as follows:

[Eq. 52]

$$f(h_{k,l}, H_{k,l}^s, B_k^s, B_k^s) = (1 - g(SIR_I \mid h_{k,l}, H_{k,l}^s, b_k, B_k^s))(1 - g(SIR_Q \mid h_{k,l}, H_{k,l}^s, b_k, B_k^s))$$
$$f(h_{k,l}, H_{k,l}^s, B_k^s e^{i\varphi_I}, B_k^s) = g(SIR_I \mid h_{k,l}, H_{k,l}^s, b_k, B_k^s)(1 - g(SIR_Q \mid h_{k,l}, H_{k,l}^s, b_k, B_k^s))$$
$$f(h_{k,l}, H_{k,l}^s, B_k^s e^{i\varphi_Q}, B_k^s) = (1 - g(SIR_I \mid h_{k,l}, H_{k,l}^s, b_k, B_k^s))g(SIR_Q \mid h_{k,l}, H_{k,l}^s, b_k, B_k^s)$$
$$f(h_{k,l}, H_{k,l}^s, -B_k^s, B_k^s) = g(SIR_I \mid h_{k,l}, H_{k,l}^s, b_k, B_k^s)g(SIR_Q \mid h_{k,l}, H_{k,l}^s, b_k, B_k^s)$$

8. A weighting coefficient determining method according to claim 7, wherein said φ_I and φ_Q are calculated according to the following:

[Eq. 53]

$$\varphi_I = \pi - 2\operatorname{atan}(\beta)$$

[Eq. 54]

$$\varphi_Q = 2\operatorname{atan}(\beta)$$

where β in the equations is a value calculated based on a power ratio γ between the I and Q branches expressed by the following equation:

[Eq. 55]

$$\beta = \frac{1}{\sqrt{\gamma}}$$

9. A weighting coefficient determining method according to claim 1, characterized in that said digital radio communications are code division multiple access (CDMA) communications.

10. An interference canceller unit in a subtractive interference canceller for digital radio communications wherein the communication channel is composed of pilot bits, other control bits and data bits; comprising

adding means for receiving and adding an interference cancellation residual signal and a replica signal from a previous stage;

despreading means for despreading the aforementioned addition signal by multiplying a spreading code of the user;

correcting means for determining a fading vector and performing transmission path correction;

tentative decision means for deciding on a symbol from the transmission path corrected signal;

weighting means for multiplying a weighting coefficient to the tentative decision symbol;

spreading means for respreading the tentative decision symbol by multiplying the spreading code of the user; and

decorrecting means for determining a replica signal by multiplying the inverse of the transmission path properties to the respread signal; and

wherein said weighting means outputs a weighting coefficient λ_A^Q of the pilots bits, a weighting coefficient λ_B^Q of the other control bits and a weighting coefficient λ^I of the data bits as separately derived values.

11. An interference canceller unit according to claim 10, wherein said weighting means determines said weighting coefficients λ_A^Q, λ_B^Q and λ^I for each user and stage based on a tentative decision symbol and an average or instantaneous signal-to-interference ratio SIR.

12. An interference canceller unit according to claim 10, wherein said weighting means derives the weighting coefficients λ^I and λ^Q of the I branch and Q branch from a tentative decision symbol and a tentative decision error probability density function derived from the signal-to-interference ratios SIR_I and SIR_Q.

13. An interference canceller unit in a subtractive interference canceller for digital

radio communications, comprising

adding means for receiving and adding an interference cancellation residual signal and a replica signal from a previous stage;

despreading means for despreading the aforementioned addition signal by multiplying a spreading code of the user;

correcting means for determining a fading vector and performing transmission path correction;

tentative decision means for deciding on a symbol from the transmission path corrected signal;

weighting means for multiplying a weighting coefficient to the tentative decision symbol;

spreading means for respreading the tentative decision symbol by multiplying the spreading code of the user; and

decorrecting means for determining a replica signal by multiplying the inverse of the transmission path properties to the respread signal; and

wherein said weighting means determines a complex weighting coefficient such as to minimize the power of the interference cancellation residual signal for each channel in each stage.

14. An interference canceller unit according to claim 13, wherein said weighting coefficients are derived based on the relationship expressed by the following equation:
[Eq. 56]

$$\lambda^s_{k,l}(H^s_{k,l}, B^s_k) = \frac{\int dh_{k,l} \int db_k h_{k,l} b_k f(h_{k,l}, H^s_{k,l}, b_k, B^s_k)}{H^s_{k,l} B^s_k}$$

wherein $\lambda_{k,l}{}^s$ denotes the weighting coefficient of the l-th path for the k-th user in the s-th stage;
$H_{k,l}{}^s$ denotes the estimated channel of the l-th path for the k-th user in the s-th stage;
$B_k{}^s$ denotes the tentative decision symbol of the k-th user in the s-th stage;
$h_{k,l}(t)$ denotes the channel coefficient of the l-th path for the k-th user;
b_k denotes the signal received by the k-th user; and
$f(h_{k,l}, H_{k,l}{}^s, b_k, B_k{}^s)$ is a combined tentative decision error probability density function relating to the channel coefficient $h_{k,l}$, the estimated channel $H_{k,l}$, the received signal b_k

and the tentative decision symbol B_k^s.

15. An interference canceller unit according to claim 14, wherein said weighting coefficients are approximated as follows:

[Eq. 57]

$$\lambda_{k,l}^{s}(H_{k,l}^{s}, B_k^s) \cong \frac{\int db_k b_k f(h_{k,l}, H_{k,l}^{s}, b_k, B_k^s)}{B_k^s}$$

16. An interference canceller unit according to claim 15, wherein said weighting coefficients are further determined by taking the received signal b_k as follows:

[Eq. 58]

$$b_k = A_k^s e^{i\varphi_k^s}$$

and using the following relationship:

[Eq. 59]

$$\frac{\int db_k b_k f(h_{k,l}, H_{k,l}^{s}, b_k, B_k^s)}{B_k^s} = \int db_k A_k^s e^{i\phi_k} f(h_{k,l}, H_{k,l}^{s}, b_k, B_k^s)$$

$$= f(h_{k,l}, H_{k,l}^{s}, B_k^s, B_k^s) + f(h_{k,l}, H_{k,l}^{s}, e^{i\varphi_I} B_k^s, B_k^s) e^{i\varphi_I}$$

$$+ f(h_{k,l}, H_{k,l}^{s}, e^{i\varphi_Q} B_k^s, B_k^s) e^{i\varphi_Q} - f(h_{k,l}, H_{k,l}^{s}, e^{i\pi} B_k^s, B_k^s)$$

wherein φ_I and φ_Q are phase errors when only the I or Q phase contains measurement errors, and are expressed as follows:

[Eq. 60]

$$\varphi_I = \mathrm{sgn}(\mathrm{real}(B_k^s))\,\mathrm{sgn}(\mathrm{imag}(B_k^s))\,2\left(\frac{\pi}{2} - \mathrm{atan}\left|\frac{\mathrm{imag}(B_k^s)}{\mathrm{real}(B_k^s)}\right|\right)$$

$$\varphi_Q = -\mathrm{sgn}(\mathrm{real}(B_k^s))\,\mathrm{sgn}(\mathrm{imag}(B_k^s))\,2\,\mathrm{atan}\left|\frac{\mathrm{imag}(B_k^s)}{\mathrm{real}(B_k^s)}\right|$$

and the terms on the righthand side of Equation 59, using the signal-to-interference ratio $SIR_{I(Q)}$ of the I(Q) branch and the tentative decision error probability of the I(Q) branch:

[Eq. 61]

$$g(SIR_{I(Q)} \mid h_{k,l}, H_{k,l}^{s}, b_k, B_k^s) = \frac{1}{\sqrt{2\pi}} \int_{\sqrt{SIR_{I(Q)}}}^{\infty} e^{-\frac{x^2}{2}} dx$$

are expressed as follows:

[Eq. 62]

$$f(h_{k,l},H_{k,l}^{s},B_{k}^{s},B_{k}^{s})=(1-g(SIR_{I}\mid h_{k,l},H_{k,l}^{s},b_{k},B_{k}^{s}))(1-g(SIR_{Q}\mid h_{k,l},H_{k,l}^{s},b_{k},B_{k}^{s}))$$
$$f(h_{k,l},H_{k,l}^{s},B_{k}^{s}e^{i\varphi_{I}},B_{k}^{s})=g(SIR_{I}\mid h_{k,l},H_{k,l}^{s},b_{k},B_{k}^{s})(1-g(SIR_{Q}\mid h_{k,l},H_{k,l}^{s},b_{k},B_{k}^{s}))$$
$$f(h_{k,l},H_{k,l}^{s},B_{k}^{s}e^{i\varphi_{Q}},B_{k}^{s})=(1-g(SIR_{I}\mid h_{k,l},H_{k,l}^{s},b_{k},B_{k}^{s}))g(SIR_{Q}\mid h_{k,l},H_{k,l}^{s},b_{k},B_{k}^{s})$$
$$f(h_{k,l},H_{k,l}^{s},-B_{k}^{s},B_{k}^{s})=g(SIR_{I}\mid h_{k,l},H_{k,l}^{s},b_{k},B_{k}^{s})g(SIR_{Q}\mid h_{k,l},H_{k,l}^{s},b_{k},B_{k}^{s})$$

17. An interference canceller unit according to claim 16, wherein said φ_I and φ_Q are calculated according to the following:

[Eq. 63]

$$\varphi_I = \pi - 2\,\mathrm{atan}(\beta)$$

[Eq. 64]

$$\varphi_Q = 2\,\mathrm{atan}(\beta)$$

wherein β in the equations is a value calculated based on a power ratio γ between the I and Q branches expressed by the following equation:

[Eq. 65]

$$\beta = \frac{1}{\sqrt{\gamma}}$$

18. An interference canceller unit according to claim 10, wherein said digital radio communications are code division multiple access (CDMA) communications.

19. A parallel subtractive interference canceller comprising a plurality of processing stages composed of a plurality of interference canceller units for handling a plurality of users, each stage aside from the final stage further comprising an adder; wherein

a replica signal is prepared by inputting a received signal and a zero value to each interference canceller unit in the first stage, and outputted to said adder and each interference canceller unit of the corresponding user in the next stage;

a replica signal for each stage from the second stage to the next-to-last stage is prepared by inputting the interference cancellation residual signal in the previous stage and said replica signal of the previous stage to each interference canceller unit, and outputted to said adder and each interference canceller unit of the corresponding user in

the next stage; and

a replica signal is prepared in each interference canceller unit of the final stage by inputting the interference cancellation residual signal of the previous stage and said replica signal of the previous stage, and outputted; and

wherein the interference canceller unit of claim 10 is used.

20. A serial subtractive interference canceller comprising a plurality of stages composed of a plurality of interference canceller units for handling a plurality of users; wherein

a replica signal is prepared by inputting a received signal and a zero value to the interference canceller unit of the first user in the first stage and outputted to the interference canceller unit of the corresponding user in the next stage, and the replica signal is subtracted from the received signal and the result is outputted to the interference canceller unit of the second user;

a replica signal is prepared by inputting a signal subtracting replica signals from the first through previous users from the received signal and a zero value to the interference canceller unit of the second and subsequent users of the first stage, outputted to the interference canceller unit of the corresponding user in the next stage, and the replica signal is subtracted from the received signal and the result outputted to the interference canceller unit of the next user;

a replica signal is prepared by inputting an interference cancellation residual signal of the first stage instead of the received signal and the replica signal from the previous stage instead of a zero value to the interference canceller unit of the first user in the second stage, and outputted to the interference canceller unit of the corresponding user in the next stage, and the replica signal is subtracted from the received signal and the result outputted to the interference canceller unit of the second user; and

a replica signal is prepared and outputted by performing the same procedure until the final stage; and

wherein the interference canceller unit of claim 10 is used.

21. A weighting coefficient determining method according to claim 4, characterized in that said digital radio communications are code division multiple access (CDMA) communications.

22. An interference canceller unit according to claim 13, wherein said digital radio communications are code division multiple access (CDMA) communications.

23. A parallel subtractive interference canceller comprising a plurality of processing stages composed of a plurality of interference canceller units for handling a plurality of users, each stage aside from the final stage further comprising an adder; wherein

a replica signal is prepared by inputting a received signal and a zero value to each interference canceller unit in the first stage, and outputted to said adder and each interference canceller unit of the corresponding user in the next stage;

a replica signal for each stage from the second stage to the next-to-last stage is prepared by inputting the interference cancellation residual signal in the previous stage and said replica signal of the previous stage to each interference canceller unit, and outputted to said adder and each interference canceller unit of the corresponding user in the next stage; and

a replica signal is prepared in each interference canceller unit of the final stage by inputting the interference cancellation residual signal of the previous stage and said replica signal of the previous stage, and outputted; and

wherein the interference canceller unit of claim 13 is used.

24. A serial subtractive interference canceller comprising a plurality of stages composed of a plurality of interference canceller units for handling a plurality of users; wherein

a replica signal is prepared by inputting a received signal and a zero value to the interference canceller unit of the first user in the first stage and outputted to the interference canceller unit of the corresponding user in the next stage, and the replica signal is subtracted from the received signal and the result is outputted to the interference canceller unit of the second user;

a replica signal is prepared by inputting a signal subtracting replica signals from the first through previous users from the received signal and a zero value to the interference canceller unit of the second and subsequent users of the first stage, outputted to the interference canceller unit of the corresponding user in the next stage, and the replica signal is subtracted from the received signal and the result outputted to the interference canceller unit of the next user;

a replica signal is prepared by inputting an interference cancellation residual signal of the first stage instead of the received signal and the replica signal from the previous stage instead of a zero value to the interference canceller unit of the first user in the second stage, and outputted to the interference canceller unit of the corresponding user in the next stage, and the replica signal is subtracted from the received signal and the result outputted to the interference canceller unit of the second user; and

a replica signal is prepared and outputted by performing the same procedure until the final stage; and

wherein the interference canceller unit of claim 13 is used.